ARMY RESEARCH LABORATORY

Closed-Loop Water Recycling System

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DYNAMIC SCIENCE, INC.

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U.S. ARMY RESEARCH LABORATORY

ARL-MR-220

May 1995

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13. ABSTRACT *(Maximum 200 words)*

The increased emphasis on environmental concerns has strongly impacted operations involving energetic materials processing. Safety requirements for these operations include a high degree of cleanliness, both of equipment and operating spaces. The recommended procedure for clean-up after an operation, steam washdown, has long been prohibited because of the pink water waste stream that results. This report describes the solution to this problem that has been implemented locally, a closed-loop system whose only effluent is water vapor and contaminated sawdust, which can be disposed of according to current regulation and procedure.

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The authors are grateful to Mr. Richard Schwanke, of the U.S. Army Research Laboratory's (ARL) Risk Management Office, for sampling the effluent from the prototype filter and having it analyzed for contaminant content, to Mr. Raymond Cregar for making his facility available for this experiment and ultimate installation of the system, and to Mr. Ona Lyman for reviewing the manuscript.

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1. PURPOSE

The primary purpose of this project was to provide employees at explosives processing facilities the means of handling explosives-contaminated water in a manner that is environmentally friendly and that complies with all laws and regulations.

Closely related to this is the issue of safety. Cleanliness is imperative in an explosives processing operation. Steam-down and wash-down operations can only be permitted if the waste water is disposed of properly or handled in other ways consistent with regulation. The proposed system avoids the problem of waste water disposal. It is safe, effective, and within the existing permits and regulations.

2. BACKGROUND

The Explosives Modeling Facility, an explosives processing pilot plant facility which is part of the U.S. Army Research Laboratory (ARL), is in operation on Spesutie Island at the Aberdeen Proving Ground (APG), MD. Explosives operations performed here include melting, casting, pressing, sawing, machining, and x-raying energetic materials, primarily explosives, gun propellants, and pyrotechnic formulations.

The problem is that most of these operations generate Reactive Hazardous Waste (RHW). In addition, as a result of the processing, the spaces within which these operations are performed become contaminated with reactive dust. The normal, and formerly approved, approach to cleaning these spaces has been a steam wash-down. Until recently, at the conclusion of a processing operation involving energetic materials, the operating bays involved would be steamed down to remove all traces of these materials. The contaminated water, or "pink water," would flow into a trough, and be led to a filter at one end of the building (B-1171). The filtered water would then be discharged to the environment.

Approximately five years ago, the Directorate of Safety, Health, and the Environment (DSHE) of the Aberdeen Proving Ground Support Activity (APGSA) made a determination that this process contributed to contamination of the environment. The filter, which was simple but effective, was considered to be at fault. It consisted of a box of sawdust, mounted at the end of the trough which led steam-down water from the operating bays to the filter.

The APGSA removed this filter and replaced it with a concrete structure—a wide, shallow trough, separated into three chambers by metal baffle plates. These chambers were filled with activated charcoal. Waste water from the steam-down entered one end of this structure, passed through the chambers, and exited the other end as discharge water. This new system proved unsatisfactory for several reasons. Surface water run-off carried debris into the filter chambers, small animals made their homes there, and the filter design was defective, forcing flow patterns which overexposed small volumes of the filter medium while leaving much of it underexposed. Also, no tests were performed to ensure that the resulting filtering was sufficiently effective to meet requirements.

These problems were partially alleviated by the installation of locally fabricated metal panels to cover the filtration system. Some additional modifications were made, but none was able to solve the principal problem—the flow rate of the entering waste water during explosives sawing operations. Flow rates were slow enough to avoid overflow during steam-down operations, but not during sawing. The sawing operation requires a minimum flow rate to maintain closure on a safety interlock switch, so this flow rate cannot be adjusted lower to meet the capacity of the filter.

In addition to these problems, certain agencies took soil samples from the surrounding area, and in one sample found evidence of explosive material. Even though repeat testing found no further evidence of contamination, this analysis was deemed to provide sufficient reason to prohibit further use of the new filter. Concomitantly, operations requiring the use of the filter were discontinued.

Simple filtration and discharge are permitted operations under the National Pollutant Discharge Elimination System (NPDES). Building 1171, the principal site in question here, is covered by an NPDES permit which is held by the APG Safety Office. It was thought that if a filter could be demonstrated to filter adequately, and to possess sufficient flow-rate capability, it might have a significant probability of approval. Continued interaction with people from the environmental office served to discourage that idea. As a result, the concept of a closed-loop system evolved. Since the filter was still the principal element of the system, an experiment was devised to demonstrate its effectiveness.

3. FILTER EXPERIMENT

The earlier filter was able to process the waste water at the required flow rates. Its active ingredient was damp, slightly compacted cellulose whose particle size spanned a wide range; it was provided as

sweepings from the Wood Model Shop. This design was considered adequate a decade ago but had never, to our knowledge, been tested by today's standards.

A test was performed to determine whether this system would adequately filter waste water under the conditions obtaining at this facility. The worst-case scenario to be satisfied resulted from the explosives sawing operation, so the test was designed to represent this set of conditions. The normal flow rate for the saw was approximately 5 gal/min continuously, so the filter was required to pass this rate of flow without overflowing. Explosive dust, such as would result from a sawing operation, was prepared in the amount that would accumulate from a half-day operation. TNT was chosen because it is the most representative of the materials processed in this facility. A hose was arranged so as to supply water to a catch pan similar to the one in the saw, and the normal flow rate for the sawing operation was used. The water was run from the catch pan into a filter similar to that formerly used, and the effluent was directed into a large, clean drum. The explosive dust was slowly added to the water in the catch pan, just as though a sawing operation were being performed. The water carried the dust into the filter where the dust was trapped and retained.

The effluent water from the filter was thoroughly analyzed. Sample parameters included oil and grease, total suspended solids (TSS), ammonia, and total Kjeldahl nitrogen (TKN). The measurement of TKN nitrogen involves the use of a specific digestion process. The end result includes all organic, inorganic, and free nitrogen, including the nitrogen from TNT.

The analyses of these samples were done by General Physics (GP) Environmental Services, Gaithersburg, MD, under GP Work Order No. 92-06-133. The Sample Analysis Report is included here as Appendix A. The data from this experiment are shown in Table 1 and can be better understood by plotting them as in Figure 1.

The final result was that the water processed by the cellulose filter exceeded (i.e., was more pure than) the Maryland Department of the Environment standard for potable water. It was cleaner than the raw water supplied for the test.

The data points were derived from the analysis reproduced in Appendix A. The data point for oil and grease plotted in the upper right corner, should be much higher than shown, but plotting it correctly would

Table 1. Data From the Filter Experiment

ARL Sample No.	Time of Sample	Comments	Assay	
			Substance	Quantity (mg/l)
477-2168-BRL-686	1100	1 liter directly from hose	oil and grease	4.20
478-2168-BRL-687	1110	1 liter directly from hose	TSS	6.00
479-2168-BRL-688	1120–1121 and 1125–1126	1/2 liter each interval	ammonia	1.15
480-2168-BRL-689	1138 and 1158	1/2 liter at each time	TKN	0.680
481-2168-BRL-690	1215	1 liter effluent	oil and grease	43.1
482-2168-BRL-691	1225	1 liter effluent	TSS	3.00
483-2168-BRL-692	1230	1 liter effluent	ammonia	0.500
484-2168-BRL-693	1240	1 liter from pan	TSS	2.00

have condensed all the other information into an unacceptablly small region. The validity of this data point is doubtful because neither oil nor grease were included in the contaminants introduced in testing this filter. If they originated at the saw used to saw the explosive, they might be expected to have appeared in the earlier sample that was analyzed for oil and grease. A possible explanation might be found in the composition of the filter aggregate itself, viz., sawdust from the Wood Model Shop. It is not known whether this material had been exposed to these contaminants prior to their insertion into the filter as the filter medium. Regardless, this has no bearing on the efficiency of this material in removing explosives from a pink water stream.

Analyses were done for oil and grease, TSS, TKN, and ammonia. Unfortunately, not all of these were performed on all of the samples taken; however, sufficient analyses were performed to establish levels and trends for these contaminants. The concentration of TSS was shown to decrease, even from the level found in the supply water. The final measurement of 3 mg/l was an order of magnitude lower than allowed for the quarterly average. Appendix B is a letter from the State of Maryland Department of the Environment establishing the standards for water that are acceptable for discharge under Permit No. 90-DP-2517, the permit under which discharge from B-1171 had been allowed. An even higher level of TSS, i.e., 60 mg/l, is permitted as a daily maximum.

(Water Analysis)

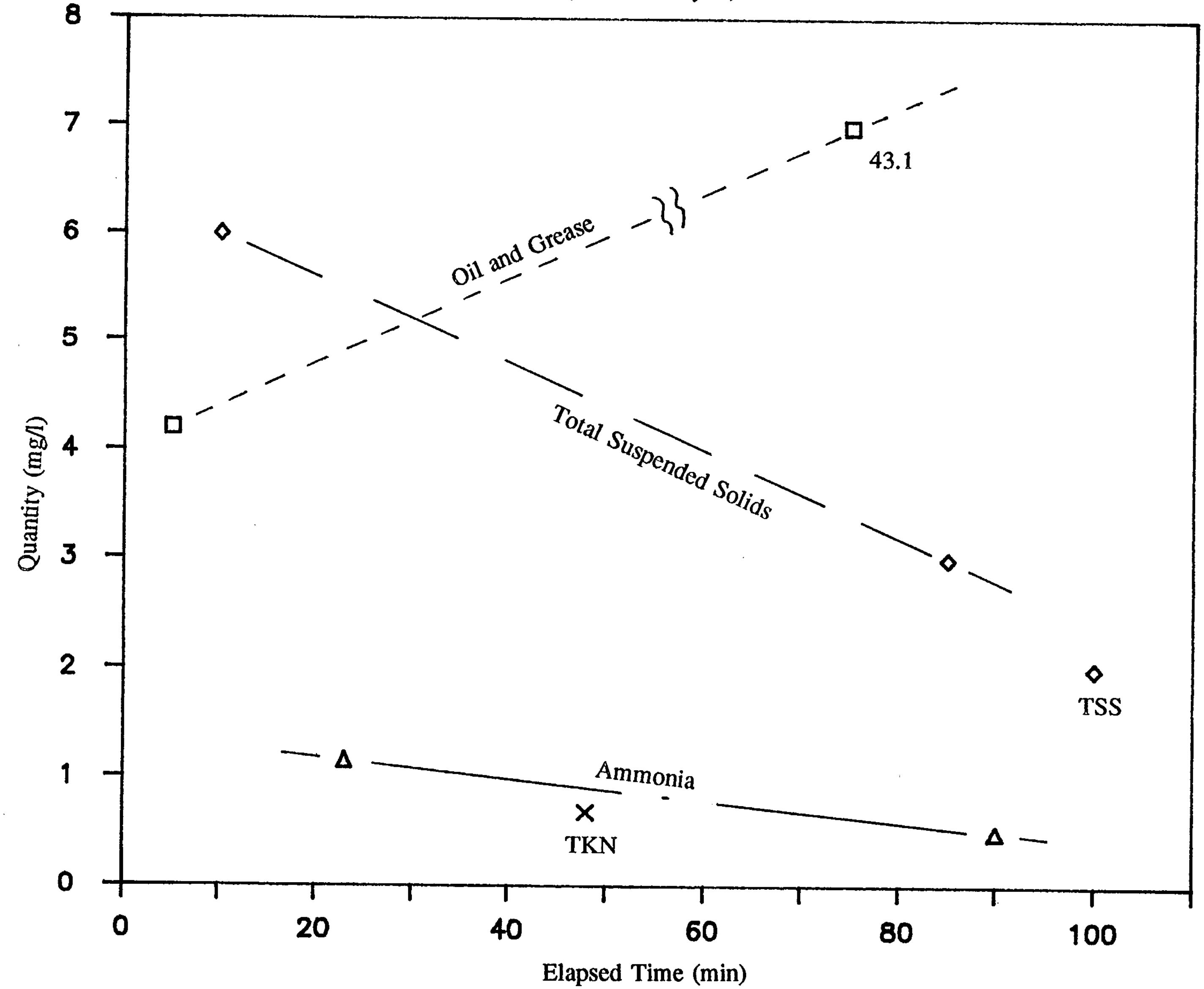

Figure 1. Effectiveness of the Cellulose Filter.

The last sample, taken at the 100-min time, was also analyzed for TSS; however, this sample was taken from the empty saw pan, essentially from the source of the water. It could be argued that the source water was becoming less TSS-contaminated as time progressed, that the hose supplying the water for the test was becoming cleaner, and that the filter had no effect. However, throughout the interval in which the TSS were decreasing, TNT powder corresponding to a half day of sawing was added to the source water, and because of the effective filtering action of the cellulose, it was not detected in the TSS analysis.

Analysis for TKN was performed on only one sample, plotted at the 48-min time. The standard indicates that monitoring is required, but that no limits have been set. The analysis showed only 0.680 mg/l, a very low level. The standard for potable water, established by the Maryland Department of the Environment, is 10 mg/l NO_3 as nitrogen, again considerably above the concentration in the filtrate.

Two samples were analyzed for ammonia. Again, the concentration was very low, and it decreased with time during the test. The standard specifies a daily maximum concentration of 90 mg/l, far above our highest assay of 1.15 mg/l.

The experiment previously described completely documented and validated the performance of the cellulose filter. Permits already exist which allow this contaminated filter to be turned in and destroyed as explosive waste, and which allow the discharge of water from this facility, providing that the water meets the currently established standard.

4. CONCEPT

It was earlier proposed that a system be installed in place of the current system to incorporate the cellulose filter and to include a settling tank. According to our experimental data, the settling tank is not necessary, but it would provide an extra measure of protection to the environment into which we would again discharge (clean) waste water. The settling tank would periodically be cleaned and the waste turned in and destroyed, as would the contaminated cellulose.

To avoid any controversy over discharge to the environment, the concept was modified to allow the water to be reused instead of being discharged. The early procedure would be reinstituted, viz., filtration of the pink water with a cellulose filter of the former design; however, no discharge, other than a

minuscule amount of evaporation, would be permitted. This concept would be implemented by closing the loop on the former procedure, i.e., returning the filtered discharge to the supply sump for further use.

As mentioned earlier, this procedure has been evaluated by the ARL Risk Management Office and found to purify the waste stream so as to make it suitable for discharge under the current license. Thus, it is more than suitable for recycling to the explosives sawing operation and to the steam wash-down system.

The potential for one further problem still exists. After considerable use, the recycled water may dissolve some nonparticulate contaminants. This may become evident by discoloration of the water. If this should occur, these contaminants could be removed by adding activated charcoal to the cellulose filter. As the water cycles through the system, it would be purified of these contaminants. In the event that this procedure is not approved, the contaminated water would be turned in as RHW. It would still be very advantageous to use this system because it would concentrate the contaminants, thus requiring turn-in of a far lower volume of RHW than if all pink water were turned in after only one use.

5. DESIGN

A prototype device has been designed, and this design has been approved by ARL Risk Management and by the APG Department of Safety, Health, and the Environment (DSHE). Figure 2 shows a schematic diagram of this design. The pink water is led from the discharge trough to the input of the filter. Effluent from the filter is held in the reservoir until the pressure switch activates the pump. Water is then pumped from the reservoir into the pressure tank, and from there, directed back to the current operation, viz., steam wash-down or explosives sawing. The water path is indicated by the arrows, indicating flow direction and/or pressure (e.g., to the pressure switch). A low-water limit switch is indicated near the bottom of the reservoir. Its function is to prevent the pump from running dry.

In operation, in the event that the water becomes contaminated (e.g., if the filter were allowed to become saturated), this system can clean itself. The contaminated filter could be removed and turned in for disposal as Resource Conservation and Recovery Act (RCRA) RHW, under existing permits. A clean filter could then be installed, and the system operated with the outlet run directly into the inlet. In this way, the system water would be repeatedly filtered until it again met the purity criterion.

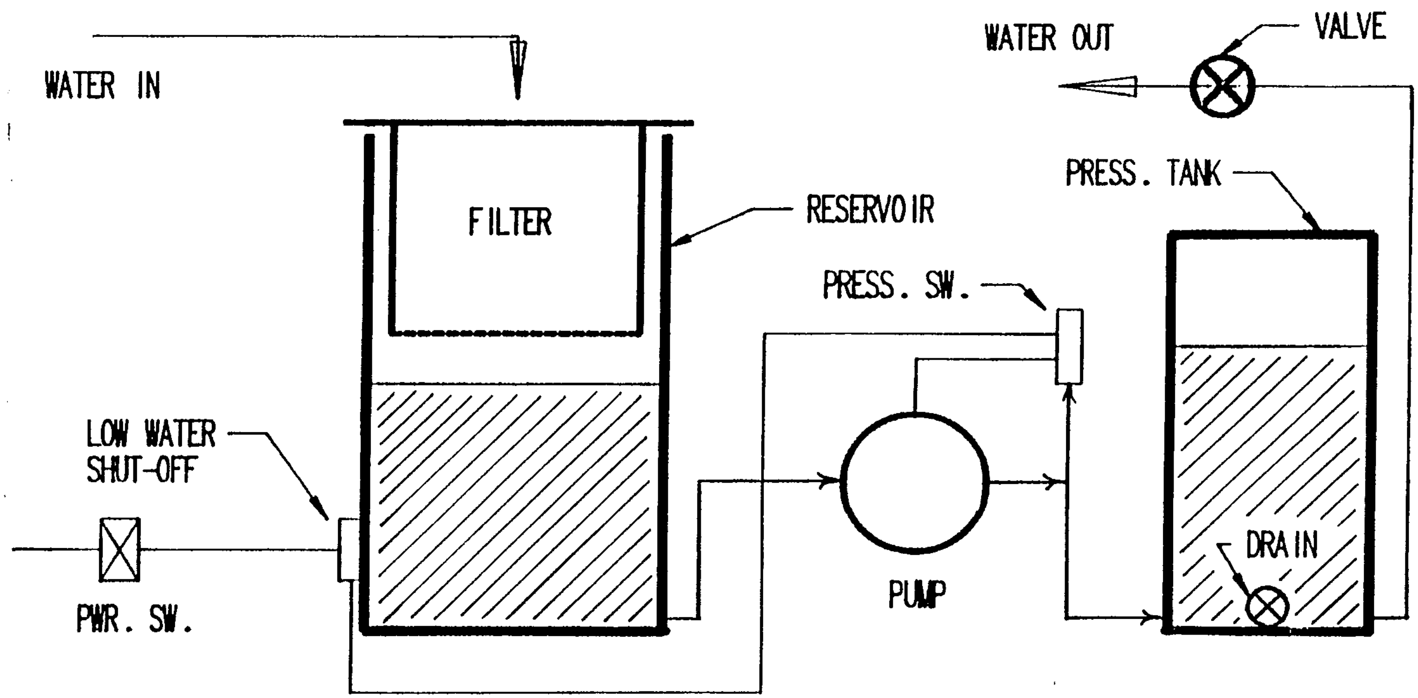

Figure 2. Schematic diagram of the closed-loop water recycling prototype.

Some water will be lost to evaporation, so occasional replenishment will be required; however, the lost vapor would be pure and so would constitute no hazard to the environment.

A simple implementation of this device has been locally fabricated. It differs in one respect from the schematic diagram of Figure 2. The initial plan was to use gravity feed from the trough directly to the filter. In implementing the design, it seemed more practical to use a third container, buried in the ground at the end of the trough to accept the pink water, and to pump the pink water from there to the cellulose filter at the inlet to the reservoir. Thus, a prefilter was needed, so that explosive particulates would not impede the pumping action or produce a hazard. A coarse bag filter acts as a prefilter, taking large particulate matter from the stream. This filter is sufficiently fine so that the centrifugal pump in this tank can pump the stream easily and safely. The pump impeller and housing are both plastic to add to the safety margin.

Environmental security is further assured by an overpack tank which surrounds the buried tank. In the event of a leak from this tank, the liquid would be contained in the overpack tank.

Figure 3 shows most of the elements of the system. The tank which was buried is shown on the right in the figure. The reservoir, which contains the cellulose filter, is in the left background, and the pressure tank with the pump on top is in the left foreground. A meter stick was placed in the center of the photo to show scale.

A detail of the tank which was buried is shown in Figure 4. The water enters the inlet on top and is distributed by the plastic Tee into the prefilter. This prefilter is shown attached to the Tee in Figure 5. The water is pumped from the buried tank to the inlet of the rectangular tank, which contains the cellulose filter. A detail of this part of the system is shown in Figure 6. When assembled, the water distribution plumbing is supported in notches in the top of the tank, and the filter box is suspended from the plumbing. Plastic hangers were locally fabricated to suspend the filter box from the plastic piping without damaging it. Figures 7 and 8 show the filter box from above and beneath, respectively.

Figure 9 shows the reservoir, with the filter box resting on its top. When this container is full of water, hydrostatic pressure tends to bow out the walls. A belly band was made and installed as shown to make the sides more rigid, and to prevent this bowing. Locking feet were also installed, one near each wheel, so that when the reservoir is correctly located, it can be locked in place.

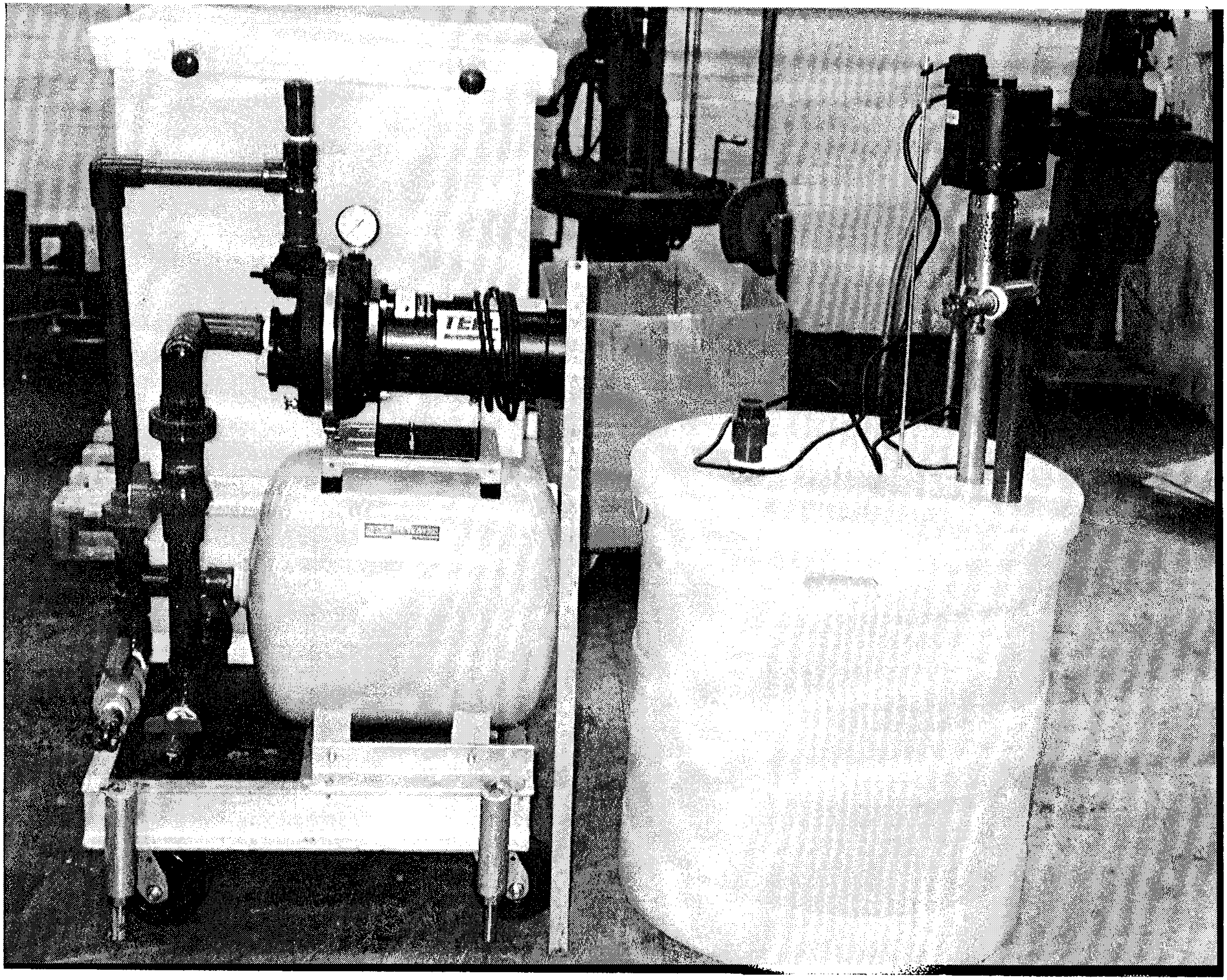

Figure 3. Photograph of the prototype system.

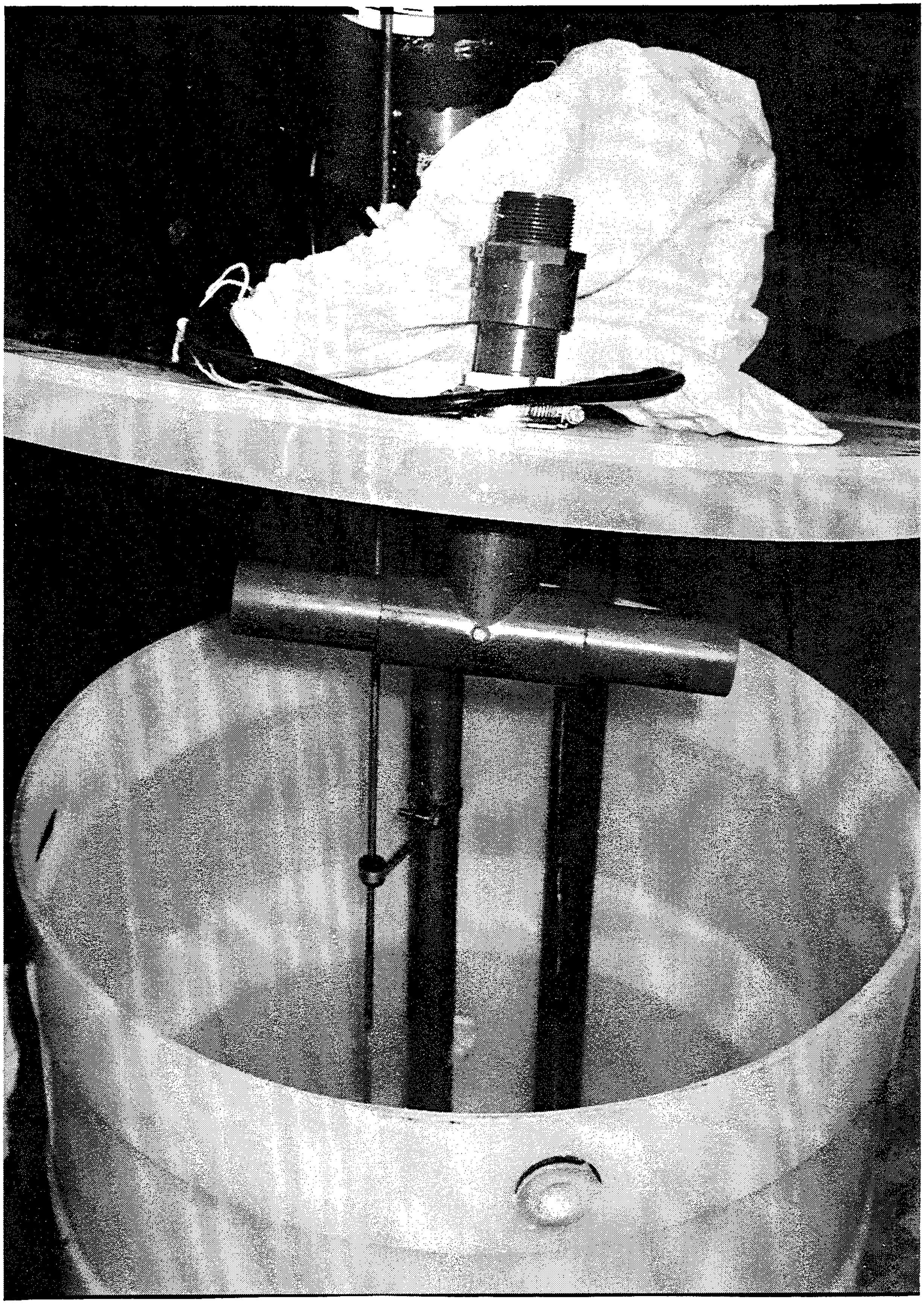

Figure 4. Initial-tank detail showing first element in the system through which the water flows.

Figure 5. Initial-tank detail showing the prefilter attached.

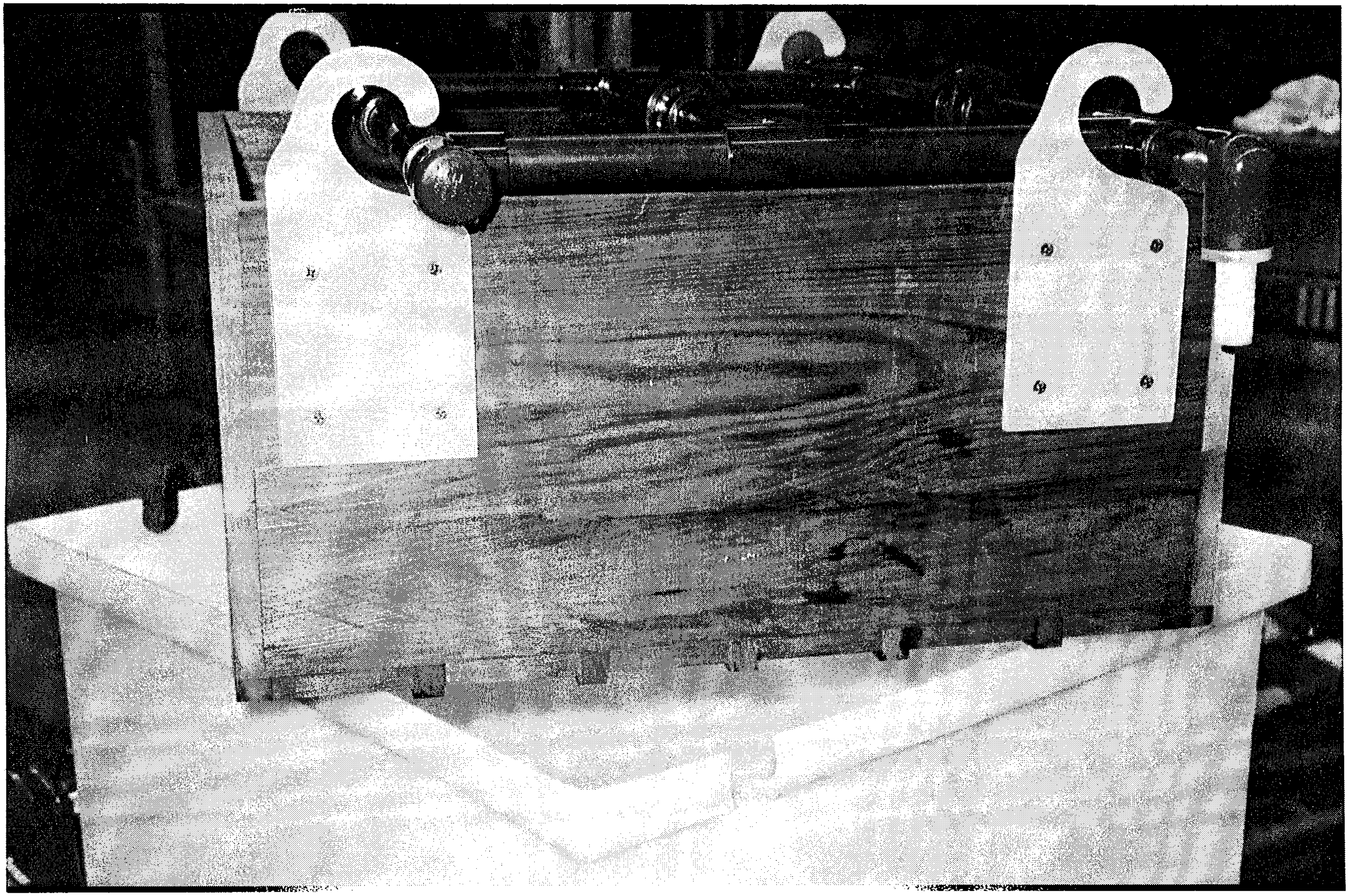

Figure 6. Detail of rectangular tank showing cellulose filter box and water distribution plumbing.

Figure 7. Filter box - top view.

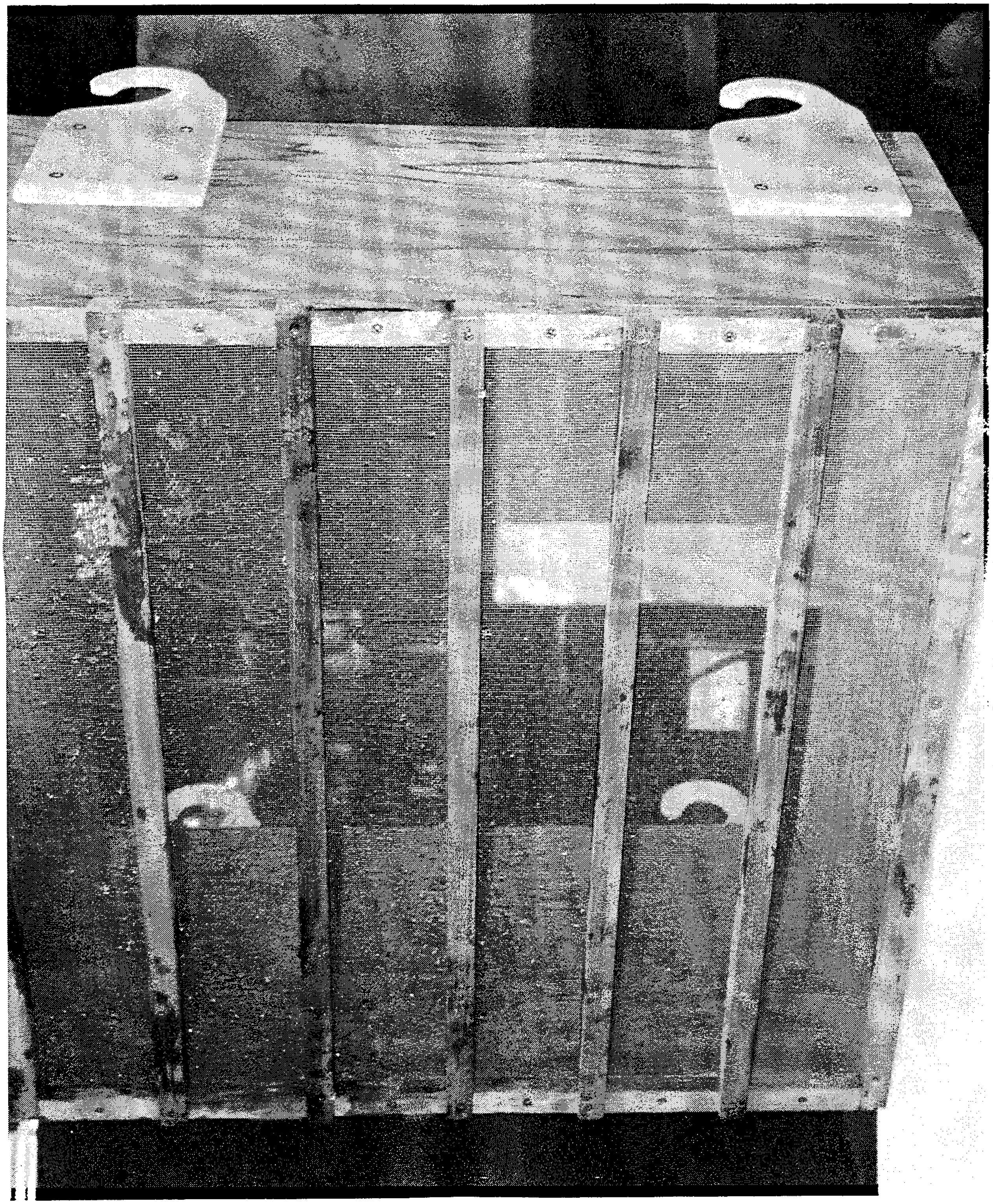

Figure 8. Filter box - bottom view.

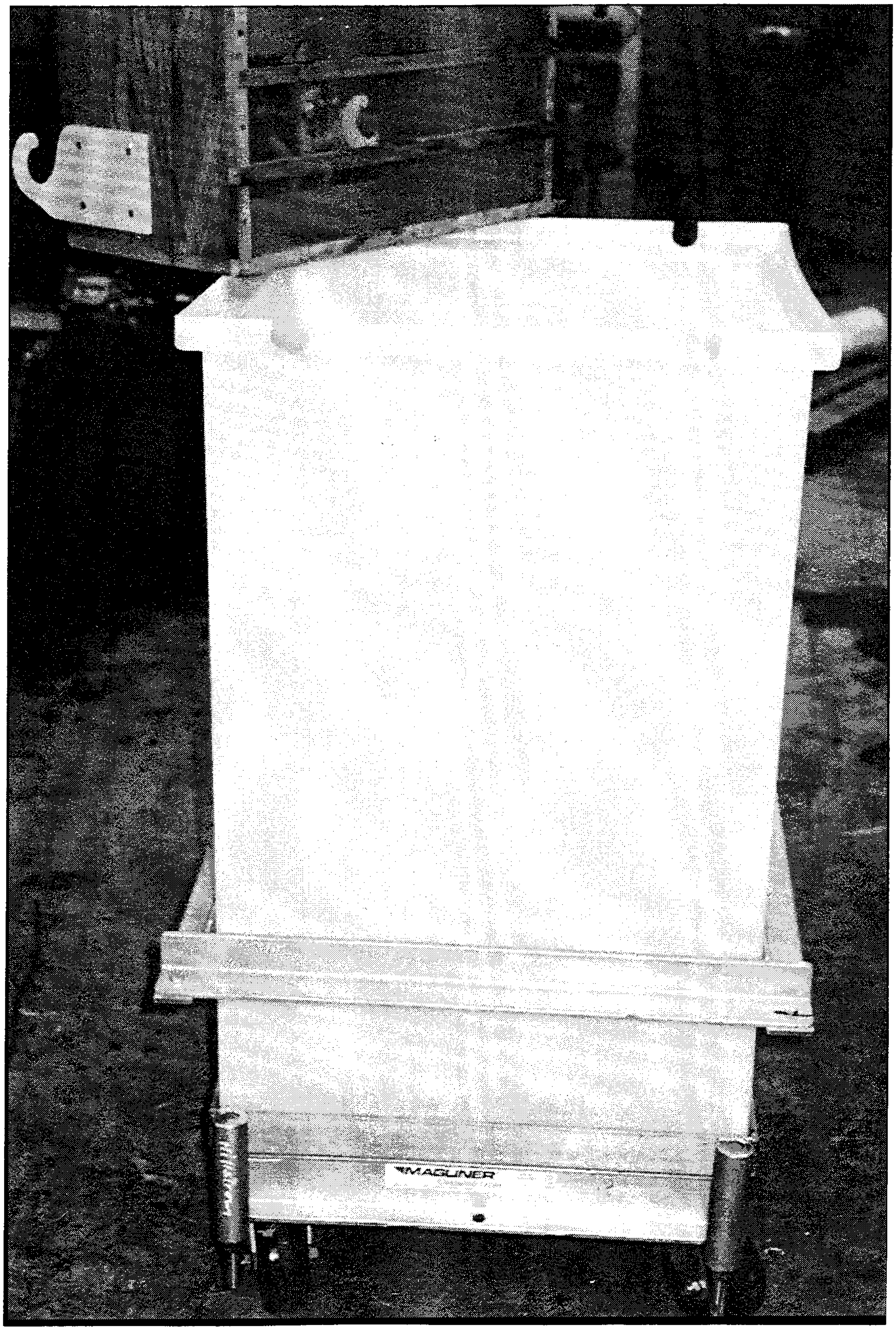

Figure 9. Reservoir showing belly band and locking feet.

6. FURTHER WORK

The concept described here is being evaluated under local conditions of use, and should be considered for wider application to the energetic materials processing community at large. This will involve the following:

(1) Refining the prototype system and incorporating improvements as indicated.

(2) Operating the system under the entire spectrum of tasks normally performed at this facility (primarily casting, sawing, and steam wash-down). This must include sawing explosives, which requires a large volume flow rate of cooling water to provide the maximum stress on the recycling system.

(3) Monitoring the recycled water for pollutants, periodically and as a function of filter saturation.

(4) Evaluating the process of filter disposal as RHW.

(5) Developing a plan for improving and finalizing the design of the next generation of this system.

7. PAYOFF

This facility is by no means unique in its requirements. All military and civilian facilities that process energetic materials have similar problems, and the solutions that have been implemented are cumbersome, expensive, and still in part, environmentally polluting.

Implementation of this system has enabled the evaluation and further development of a system capable of recycling pink water, so that safety requirements at explosives processing facilities (and likely many other types of facilities) can be met. This system, or something very similar to it, will most likely find widespread application throughout industry in the avoidance of environmental pollution.

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APPENDIX A:

SAMPLE ANALYSIS REPORT

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GP Work Order # 92-06-133

SAMPLE ANALYSIS REPORT

Prepared For:

Dir. of Safety, Health & Env.
Bldg. EA 4430, Aberdeen
Edgewood, MD 21010-5401

ARM 410

Prepared By:

GP Environmental Services
202 Perry Parkway
Gaithersburg, Maryland 20877

July 13, 1992

for Paul Ioannides, Laboratory Director

GP ENVIRONMENTAL SERVICES
WET CHEMISTRY ANALYSIS RESULTS

GP ID: 9206133-01A
Client ID: 477-2168-BRL 686

Collected: 06/17/92
Matrix: WATER

Parameter	Method	Result	Det.Lim.	Units	Dil.	Analyzed by
15 ppm Oil and Grease, Gravimetric	MCAWW 413.1	4.20	1.10	mg/L		CM 07/07/92

mg/l

GP ID: 9206133-02A
Client ID: 478-2168-BRL 687

Collected: 06/17/92
Matrix: WATER

Parameter	Method	Result	Det.Lim.	Units	Dil.	Analyzed by
60 Total Suspended Solids	MCAWW 160.2	6.00	1.00	mg/L		CM 06/22/92

GP ID: 9206133-03A
Client ID: 479-2168-BRL 688

Collected: 06/17/92
Matrix: WATER

Parameter	Method	Result	Det.Lim.	Units	Dil.	Analyzed by
Ammonia	MCAWW 350.3	1.15	0.0300	mg/L	1	VHM 07/10/92

GP ID: 9206133-04A
Client ID: 480-2168-BRL 689

Collected: 06/17/92
Matrix: WATER

Parameter	Method	Result	Det.Lim.	Units	Dil.	Analyzed by
Total Kjeldahl Nitrogen	MCAWW 351.4	0.680	0.0300	mg/L	1	VHM 07/02/92

GP ID: 9206133-05A
Client ID: 481-2168-BRL 690

Collected: 06/17/92
Matrix: WATER

Parameter	Method	Result	Det.Lim.	Units	Dil.	Analyzed by
Oil and Grease, Gravimetric	MCAWW 413.1	43.1	1.10	mg/L		CM 07/07/92

Total N = Nitrate/Nitrites; TKN; Ammonia

Notes and definitions for this report:
BQL = Below Quantitation Limit

GP ENVIRONMENTAL SERVICES
WET CHEMISTRY ANALYSIS RESULTS

GP ID: 9206133-06A
Client ID: 482-2168 BRL 691

Collected: 06/17/92
Matrix: WATER

Parameter	Method	Result	Det.Lim.	Units	Dil.	Analyzed by
Total Suspended Solids	MCAWW 160.2	3.00	1.00	mg/L		CH 06/22/92

GP ID: 9206133-07A
Client ID: 483-2168-BRL 692

Collected: 06/17/92
Matrix: WATER

Parameter	Method	Result	Det.Lim.	Units	Dil.	Analyzed by
Ammonia	MCAWW 350.3	0.500	0.0300	mg/L	1	VHM 07/10/92

GP ID: 9206133-08A
Client ID: 484-2168-BRL-693

Collected: 06/17/92
Matrix: WATER

Parameter	Method	Result	Det.Lim.	Units	Dil.	Analyzed by
Total Suspended Solids	MCAWW 160.2	2.00	1.00	mg/L		CH 06/22/92

C.O.D. also required at 1171, 700

Notes and definitions for this report:
BQL = Below Quantitation Limit

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APPENDIX B:

EFFLUENT STANDARD

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STATE OF MARYLAND
DEPARTMENT OF THE ENVIRONMENT
2500 Broening Highway Baltimore, Maryland 21224
(410) 631- 3304

William Donald Schaefer
Governor

Robert Perciasepe
Secretary

April 29, 1992

CERTIFIED MAIL

Mr. Michael Flannery
Department of the Army
Aberdeen Proving Ground
Aberdeen MD 21005

Dear Mr. Flannery:

Enclosed are the modified pages of your validated State Discharge Permit No. 90-DP-2517A. Please insert these into your copy of the discharge permit replacing or supplementing the appropriate existing pages.

The effective date of the modification is indicated on the new cover page. The effective date for those limitations or conditions not affected by the modification remains as specified on the first page of the permit.

Should you have any questions concerning the modification, please call Mr. Edward Gertler of the Industrial Discharge Program at (410) 631-3323. Questions regarding the other aspects of the permit should be referred to the Enforcement Program at (410) 631-3409.

Sincerely,

RW Collins

Richard Collins, Director
Hazardous and Solid Waste
Management Administration

RC:cat

Enclosures

cc: Mr. Harold Dye
Mr. Lawrence Liu
Mr. Horacio Tablada

STATE OF MARYLAND
DEPARTMENT OF THE ENVIRONMENT
2500 Broening Highway Baltimore, Maryland 21224
(410) 631- 3304

STATE DISCHARGE PERMIT NUMBER	90-DP-2517A
NPDES PERMIT NUMBER	MD0003565A
EFFECTIVE DATE	August 8, 1991
EXPIRATION DATE	August 8, 1996

EFFECTIVE DATE OF MODIFICATION	May 6, 1992

Pursuant to the provisions of Title 9 of the Environment Article, Annotated Code of Maryland and regulations promulgated thereunder and the provisions of the Clean Water Act, 33 U.S.C. § 1251 et seq. and implementing regulations 40 CFR Parts 122, 123, 124, and 125, the Department of the Environment, hereinafter referred to as the "Department," hereby authorizes

Department of the Army
Aberdeen Proving Ground
Aberdeen, Maryland 21005

TO DISCHARGE FROM

a facility testing weapon systems, ordnance, and chemical warfare agents

LOCATED AT

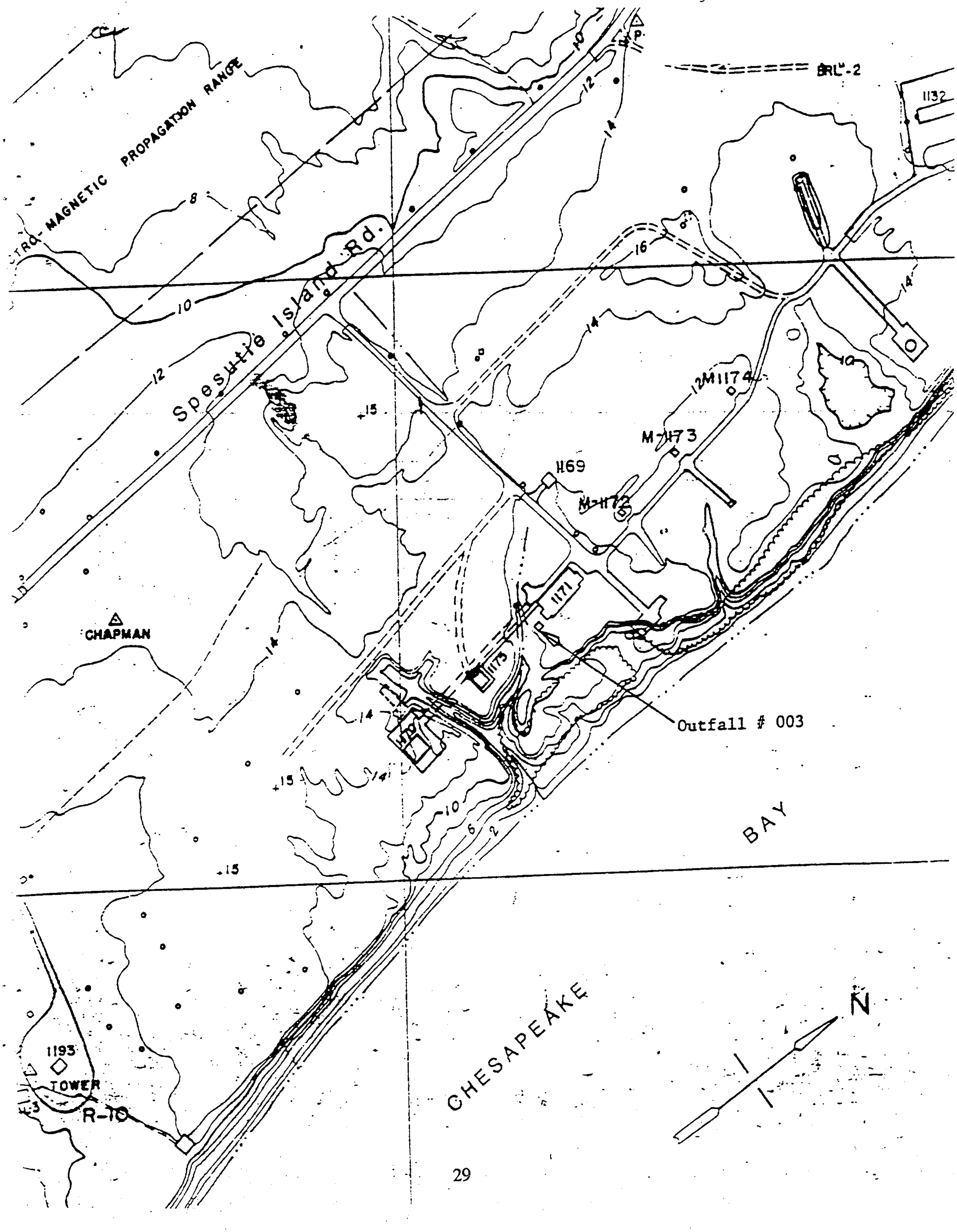
Aberdeen Proving Ground, Harford County, Maryland

VIA OUTFALL

003, 004, 005, 006, 007, 009, 010, 012, 013, and 014 as identified and described herein

TO

Gunpowder River (006), Dipple Creek (012), Woodrest Creek (009, 013), and Bush River (014), which are protected for shellfish harvesting, to Deer Creek (005), which is protected for public water supply and recreational trout fishing, and to Sod Run (007), Swan Creek (010), tributary of Chesapeake Bay (003) and Romney Creek (004) which, along with the above-mentioned waterways, are protected for water contact recreation, fishing, aquatic life, and wildlife in accordance with the following special and general conditions and map made a part hereof.


BRL-2
1132
ELECTRO-MAGNETIC PROPAGATION RANGE
Spesutie Island Rd.
M1174
M-1173
1169
M-1172
1171
1173
Outfall # 003
CHAPMAN
BAY
CHESAPEAKE
N
1193
TOWER
R-10

I. SPECIAL CONDITIONS

A. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

Beginning on the effective date of the permit and lasting through the expiration date the permittee is authorized to discharge from outfalls 003 and 004, consisting of washdown water from shell cases and equipment.

Such discharge shall be monitored by the permittee and limited at exit from charcoal filters as specified below:

CONSTITUENT	EFFLUENT LIMITATIONS (lbs/day)		EFFLUENT LIMITATIONS Other Units (Specify)		MONITORING REQUIREMENTS	
	Quarterly Average	Daily Maximum	Quarterly Average	Daily Maximum	Measurement Frequency	Sample Type
Flow (gpd)	N/A	N/A	(1)	(1)	1/month	estimated
Oil and Grease	N/A	N/A	(1)	15 mg/l	1/month	grab
Total Suspended Solids	N/A	N/A	(1)	60 mg/l	1/month	grab
Total Ammonia (as N)	N/A	N/A	(1)	90 mg/l	1/month (2)	grab
Total Nitrogen (as N)	N/A	N/A	(1)	(1)	1/month	grab

The pH shall not be less than 6.0 nor greater than 9.0 and shall be monitored once per month by grab sample.

There shall be no discharge of floating solids or persistent foam in other than trace amounts. Persistent foam is foam that does not dissipate within one half-hour of point of discharge.

(1) Monitoring required without limits.

(2) During the months of June, July, and August only.

I. SPECIAL CONDITIONS

B. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

Beginning on the effective date of the permit and lasting through the expiration date the permittee is authorized to discharge from outfalls 005, 006, and 007, consisting of vehicle and aircraft washwater, and stormwater.

Such discharge shall be monitored by the permittee and limited at ditch from ponds (005 and 006) and ditch from third sediment pond (007) as specified below:

CONSTITUENT	EFFLUENT LIMITATIONS				MONITORING REQUIREMENTS	
	(lbs/day)		Other Units (Specify)			
	Quarterly Average	Daily Maximum	Quarterly Average	Daily Maximum	Measurement Frequency [1]	Sample Type
Flow, gpd	N/A	N/A	[2]	[2]	1/month	grab
Total Petroleum Hydrocarbons	N/A	N/A	[2]	15 mg/l	1/month	grab
Total Suspended Solids [3]	N/A	N/A	30 mg/l	60 mg/l	1/month	grab

The pH shall not be less than 6.0 [4] nor greater than 9.0 and shall be monitored once per month by grab sample.

There shall be no discharge of floating solids or persistent foam in other than trace amounts. Persistent foam is foam that does not dissipate within one half-hour of point of discharge.

(1) All parameters to be sampled when there has been no precipitation during the previous 24 hours.

(2) Monitoring required without limits.

(3) Net TSS limit for Outfall 005 only. Background sample for intake water will be taken at culvert uphill from oil-water separator.

(4) The lower pH limit for Outfall 007 will be the ambient pH of the intake water at the time of discharge.

I. SPECIAL CONDITIONS

C. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

Beginning on the effective date of the permit and lasting through the expiration date the permittee is authorized to discharge from outfalls 009, 010, 012, and 013, consisting of noncontact cooling water.

Such discharge shall be monitored by the permittee and limited at 2-ft. corrugated pipe (009), 2-ft. storm drain pipe (010), 200 ft. downstream from head wall (012), and at exit from pond before riprap (013) as specified below:

CONSTITUENT	EFFLUENT LIMITATIONS				MONITORING REQUIREMENTS	
	(lbs/day)		Other Units (Specify)			
	Quarterly Average	Daily Maximum	Quarterly Average	Daily Maximum	Measurement Frequency (1)	Sample Type
Flow, gpd	N/A	N/A	(2)	(2)	1/month	estimated
Temperature, °F	N/A	N/A	(2)	(2)	1/month	i-s
Total Residual Chlorine	N/A	N/A	N/A	<0.1 mg/l	1/month (3)(4)	grab

There shall be no discharge of floating solids or persistent foam in other than trace amounts. Persistent foam is foam that does not dissipate within one half-hour of point of discharge.

(1) All parameters to be sampled when there has been no precipitation for 24 hours.

(2) Monitoring required without limits.

(3) To be analyzed within 15 minutes after collection of the sample.

(4) Outfall 009 and 010 to be monitored from 90 and 180 days, respectively, after the effective date of the permit through the expiration date.

I. SPECIAL CONDITIONS

D. DEFINITIONS

1. The "monthly, quarterly, semi-annual, or annual average" effluent limitation by concentration means the highest allowable value calculated by computing the arithmetic mean of all the daily determinations of concentration made during any calendar month, 3-month, 6-month, or 12-month period respectively.

2. The "daily maximum" effluent limitation by concentration means the highest allowable reading of any daily determination of concentration.

3. "Daily determination of concentration" means one analysis performed on any given sample representing 24-hours flow, with one number in mg/l as an outcome.

4. "Grab Sample" means an individual sample collected in less than 15 minutes.

5. "i-s" = immersion stabilization - means a calibrated device immersed in the effluent stream until the reading is stabilized.

6. The "daily maximum" temperature means the highest temperature observed during a 24-hour period or, if flows are of shorter duration during the operating day.

7. "Bypass" means the intentional diversion of wastes from any portion of a treatment facility.

8. "Upset" means the exceptional incident in which there is unintentional and temporary noncompliance with technology-based permit effluent limitations because of factors beyond the reasonable control of the permittee. An upset does not include noncompliance to the extent caused by operational error, improperly designed treatment facilities, inadequate treatment facilities, lack of preventive maintenance, or careless or improper operation.

9. "Estimated" flow means a calculated volume or discharge rate which is based on a technical evaluation of the sources contributing to the discharge including, but not limited to, pump capabilities, water meters, and batch discharge volumes.

10. "Total Nitrogen" means the sum of total Kjeldahl nitrogen, nitrate, and nitrite as nitrogen.

E. TOXIC POLLUTANT REPORTING

The permittee shall notify the Department as soon as it is known or suspected that any toxic pollutants which are not specifically limited by this permit have been discharged at levels specified in 40 CFR Part 122.42(a).

F. REMOVED SUBSTANCES

1. Within 90 days of the effective date of the permit, unless already submitted with the application, the permittee shall submit to the Department on a form provided, the following information:

   a. Locate, on a suitable map, all areas used for the disposal of any Removed Substances as defined by General Condition B.7;

   b. The physical, chemical, and biological characteristics, as appropriate, quantities of any Removed Substances handled, and the method of disposal;

   c. If disposal is handled by other than the permittee, identify the contractor or subcontractor, their mailing address, and the information specified in a and b above.

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